Kealing Island. "The insects were observed *at night and during heavy rain,* suggesting nocturnal migration with the possibility that they were seeking shelter from the rain, or were attracted by lights in the cabin. This power of extended migration will also account for the extension of the species over the whole intertropical zone, and far beyond it on either side."

## EMBRYOLOGY.[1]

**Movements of Blastomeres.**—In a lengthy and detailed paper Professor Roux[2] gives the results of certain experiments upon the isolated cells of the morulas and young gastrulas of the frog. In previous papers he had shown that when the cells are teased apart in solutions of salt or of white of egg they may move together again, traversing short distances without any apparent means. He considered that cells attracted one another somewhat as do sperm and ovum and relegated such attractive phenomena to the field of chemical influences.

In the present paper minute and rigorously classified descriptions are given of changes which such cells undergo when once they have come into contact.

In general two or more cells in contact glide, or crawl as it were, upon one another into some new relative position. This movement of one or both may be accompanied by a revolving or waltzing, very slowly. The form of the cells becomes changed very markedly, as is especially well shown when three cells form a row. In this case the middle one is very much compressed, as if the cells crowded together with great force.

The rearrangements and changes of shape are in some cases much as take place with soap bubbles and might be explained as the resultant of the surface tensions of the separate bubbles or cells. But in many cases the arrangements are directly opposed to the laws governing the arrangements of soap bubbles and cannot be explained on so simple a basis.

Besides the external changes in form and position there are internal changes, as is made evident by the changes in position of the pigment. In such cells as have more or less pigment this may recede from the surface to appear again in concentrated form at some one region of the

[1] Edited by E. A. Andrews, Baltimore, Md., to whom abstracts reviews and preliminary notes may be sent.

[2] Archiv f. Ent. d. Org., III, June 12, 1896, pps. 381–464.

cell. When several cells are together the arrangement of the pigment appears to be in some way determined with reference to the arrangement of the cells, being at like poles or in zones, etc., according to the way the cells are combined.

The bearing of these facts upon normal development becomes evident when we recall that not only are rearrangements of cells of importance in the normal processes of cleavage in many eggs, but that they also seem to play an important part in the formation of the later embryo in the case of the eggs of Ascaris as emphasized by O. zur Strassen.[3]

Such movements of cells may then he looked for as a not unimportant factor in the production of the characteristic shapes and organs of embryos.

The explanation of the nature of these movements is by no means ready. The author recognizes that simple surface tension of a homogeneous material will not account for all the phenomena, but he is inclined to think that surface tension may be a sufficient cause provided there were a change in its character at different parts of the same cell and at different times in the same area owing to some change in the nature of the material of the cell.

**A Mechanical Explanation of Cell Division.**—As the phenomena of cell division form so large a part of the visible changes the embryologist studies, he will eagerly welcome any clue to their better understanding. Especially when we are offered an explanation of the complex changes of indirect or mitotic cell division, which figure so strikingly in the important early changes the egg undergoes. If weary of the idea of muscle-like contractility of fibres or the mysterious movements of chromosomes under chemical influences he will turn with relief to the mechanical views presented by Dr. Ludwig Rhumbler.[4]

The keynote of this honest attempt lies in the assumption that the observed physical changes of cell division may be due to purely *physical* causes, whatever the complexity and differences of the unknown *chemical* factors lying back of these physical changes.

The author first assumes that protoplasm is a viscous fluid, next that it has essentially the structure claimed by Bütschli, that is he regards protoplasm as a froth or foam of more liquid drops or *alveoli* surrounded by less liquid surfaces or lamellæ—in which may be fibres of soft granules arranged in rows.

In such a foam radiating lines may appear from the arrangements of the vesicles or alveoli and the author assumes that the radiations in

[3]See American Naturalist, Dec. 1896, p. 1059.

[4]Archiv f. Ent. der Organismen, III, July 21, 1896, pps. 527–618.

cleaving cells are of this nature and not due to actual threads. That radiations may be formed in various preparations of soap-suds and mixture of white of egg and gelatine is shown by careful figures and by diagrams and the similarity of such artificial radiations to cell radiation demonstrated. Here a contraction of a central body, as an air-bubble, suggests the way in which the centrosome may act.

In elucidating the phenomena of cell division on the basis of a foam structure the author takes the figures given by Ziegler for sea-urchin and nematode as a norm. In these eggs the nucleus and the attraction spheres undergo very marked changes in size while the radiations in the protoplasm outside the nucleus quickly grow long and then short. These rhythmic changes of size and distinctness lead to the following assumptions.

The centrosome absorbs liquid from the surrounding cytoplasm and then concentrates it into smaller bulk than it formerly occupied. The nucleus swells from absorbtion of liquid. The detailed application of these assumed factors to the phenomena of cell division cannot well be given in the bounds of an abstract and must be sought in the original. The author there sets forth how the absorbtion of liquid by the centrosome will lead to the formation of radiations, asters, as well as to the removal of yolk bodies, etc. from the neighborhood of the centrosome. The final division of the centrosome is brought about only in consequence of the swelling of the nucleus. This body removes liquid from the regions not affected by the centrosomes and this removal of liquid will cause a strain which may be represented as a system of curves concentric with the nucleus. Where the centrosome lies the cytoplasm is already less liquid, more viscid, while on the opposite side of the nucleus it is most liquid.

The removal of liquid from lines of alveoli causes the alveoli to become smaller and thus the rows exercise a pull upon the region of the centrosome. This pull of the alveolar material eventually parts the centrosome and draws the halves asunder. As the rows of alveoli that surround the nucleus are the longest their contraction under continued loss of liquid to the nucleus will lead to the separation of the centrosome halves till they reach the poles of the nucleus.

The observed second increase in size of the centrosomes follows this period of nuclear swelling and leads to the formation of new sets of radiations. These radii, or lines of alveoli, now reach to the cell wall and exert a pull upon it as liquid is taken in from the alveoli to the centrosomes. As the rows of alveoli become most viscid near the centrosome a more liquid region is left in the equatorial plane and here the

alveolar rows finally break in the cleavage of the cytoplasm. Meanwhile the vacuole-like nucleus has been pulled apart towards the centrosomes.

After the cleavage of the cell the centrosome again ceases to absorb liquid and so passes into the resting stage. The case where there is an immediate division of the centrosome into two that remain for the subsequent cell divisions also admits of explanation upon this alveolar basis; the same is true of various other cases and phenomena.

If this attempt at an understanding of the complex marvels of cell division appears much too ineffectual it is partly due to the imperfect representation given in this abstract and in part the result of the unfinished character of the present paper which claims to be but the first of a series. In the next article the author hopes to consider the nucleus with its chromosomes and spindle; and we cannot well judge of the success or failure of the attempt till that part lies before us.

Probably few will judge that much ultimate truth has yet been discovered in the attempted explanation of such exceedingly complex phenomena but if it prove that the right line of research has been struck the author has added much to our conceptions of the forces at work in embryological processes.

## PSYCHOLOGY.[1]

**Experiment on Reinversion of the Retinal Image.**—The inversion of the image on the retina, and its influence upon our visual perception of space, have given rise to considerable discussion in the past. That we see things in an upright position notwithstanding this inversion, has seemed to many writers to require special explanation. Accordingly, some have assumed a reinversion of the image in the cerebral cortex, while others have adopted a theory of visual projection which makes the retinal inversion essential to upright vision. During all this discussion the possible relativity of *up* and *down* escaped notice for a long time. What we mean by down is simply the *ground side*, and by up simply the *sky side*. As everything imaged on the retina is inverted, there is no point of reference to give an indication of the inversion of the rest. The only problem that arises, then, is concerning the co-ordination of visual with tactile space. This is a real difficulty: I see my left hand *down* at my *left* side; I feel it in the same place. How can this co-ordination be reconciled with the fact of retinal

[1] Edited by H. C. Warren, Princeton University, Princeton, N. J.